VOL. X PART VI. 1924

THE

INDIAN FOREST RECORDS

GENERAL VOLUME TABLES FOR *SAL* (*SHOREA ROBUSTA*)

CLASSIFIED BY DIAMETER AND HEIGHT

BY

S. H. HOWARD, B.A.,

Silviculturist, Forest Research Institute, Dehra Dun

Published by Order of the Government of India

DELHI
GOVERNMENT CENTRAL PRESS
1924

Price Re. 1. As. 7.

FOREST RECORDS.

Vol. I, Part I.—A Note on the Lac Insect (*Tachardia lacca*), its Life-History, Propagation and Collection, by E. P. Stebbing, F.L.S., F.Z.S., F.E.S., Imperial Forest Zoologist. Price 1-4-0. (*Out of print.*)

„ Part II.—A Preliminary Note on the Development of the Sal in Volume and in Money-Value, by A. M. F. Caccia, M.V.O., F.Z.S., Imperial Superintendent of Forest Working-Plans. Price 1-4-0. (*Out of print.*)

„ Part III. (1. *Pterocarpus dalbergioides*, Roxb. (Andaman Padouk), by B. B. Osmaston, F.C.H., Deputy Conservator of Forests, Andamans. 2. A further Note on the Chilgoza Bark-Boring Beetles of Zhob, by E. P. Stebbing, F.L.S., F.Z.S., F.E.S. (Embodying a Report by Captain E. H. S. James, I.A., Political Agent, Zhob.) 3. A Note on the Present Position and Future Prospects of the Cutch Trade in Burma, by R. S. Troup, F.C.H., Imperial Forest Economist. 4. Note on the Manufacture of Ngai Camphor, by Puran Singh, F.C.S., Acting Forest Chemist. Price 1-4-0. (*Out of print.*)

„ Part IV. (1. A Chemical Investigation of the Constituents of Burmese Varnish (*Melanorrhœa usitata*, Sap.), by Puran Singh, F.C.S., Acting Forest Chemist. 2. The Selection System in Indian Forests as exemplified in Working-Plans based on this system, with a short description of some Continental Methods, by A. M. F. Caccia, M.V.O., F.Z.S., Imperial Superintendent of Forest Working Plans. Price 1-4-0. (*Out of print.*)

Vol. II, Part I.—Note on some Insect Pests of the Himalayan Oaks (*Quercus dilatata* and *Q. incana*), by E. P. Stebbing, F.L.S., F.Z.S., F.R.G.S., F.E.S., Imperial Forest Zoologist. Price 0-6-0. (*Out of print.*)

„ Part II.—Note on the Fissibility of some Indian Woods, by R. S. Troup, F.C.H., Imperial Forest Economist. Price 1-6-0. (*Out of print.*)

„ Part III. (1. Monograph on the Sylviculture of *Hardwickia binata* (Anjan), by D. O. Witt, I.F.S., Deputy Conservator of Forests, Central Provinces. 2. Notes on Sandal (Germination and Growth of Sandal Seedlings), by Rao Sahib M. Rama Rao, Conservator of Forests, Travancore. Price 3-4-0.

„ Part IV.—Note on Host Plants of the Sandal Tree, by the same author. Price 2-0-0.

Vol. III, Part I.—Note on some Statistical and other Information regarding the Teak Forests of Burma, by R. S. Troup, I.F.S., F.C.H., Sylviculturist. Price 2-12-0.

„ Part II.—Preliminary Note on the Antiseptic Treatment of Timber in India with special reference to Railway Sleepers, by R. S. Pearson, I.F.S., Economist. Price 0-14-0.

„ Part III.—Report on the Investigation of Bamboos as Material for Production of Paper-pulp, by W. Raitt, Paper Expert. Price 0-6-0. (*Out of print.*)

„ Part IV.—Note on the preparation of Tannin Extract with special reference to those prepared from the Bark of Mangrove (*Rhizophora mucronata*), by Puran Singh, F.C.S., Forest Chemist. Price 0-7-0.

Vol. IV, Part I.—Note on the Distillation and Composition of Turpentine Oil from Chir Rosin, and the Clarification of Indian Rosin, by the same author. Price 0-9-0.

„ Part II.—Note on some new and other species of Hymenoptera in the Collections of the Zoological Branch of the Forest Research Institute, Dehra Dun, by P. Cameron. Price 0-4-0.

„ Part III.—Note on Useful Exotics in Indian Forests (No. 1 *Prosopis juliflora* D.C.), by R. S. Hole, F.C.H., F.L.S., F.E.S., Forest Botanist. Price 0-4-0.

„ Part IV.—Note on *Albizzia Lathamii*, by the same author. Price 0-3-0.

„ Part V.—Note on the Utilization of Bamboo for the Manufacture of Paper pulp, by R. S. Pearson, I.F.S., F.L.S., Economist. (2nd edition.) Price 2-0-0

[*Continued on page 3 of cover.*]

VOL. X PART VI.

THE

INDIAN FOREST RECORDS

GENERAL VOLUME TABLES FOR *SAL* (*SHOREA ROBUSTA*)

CLASSIFIED BY DIAMETER AND HEIGHT

BY

S. H. HOWARD, B.A.,

Silviculturist, Forest Research Institute, Dehra Dun

Published by Order of the Government of India

DELHI
GOVERNMENT CENTRAL PRESS
1924

Price Re. 1. As. 7.

Agents for the Sale of Books published by the Superintendent of Government Printing, India, Calcutta.

IN EUROPE.

Constable & Co., 10, Orange Street, Leicester Square, London, W. C.
Kegan Paul, Trench, Trubner & Co., 68-74, Carter Lane, E.C., and 39, New Oxford Street, London, W.C.
Bernard Quaritch, 11, Grafton Street, New Bond Street, London, W.
P. S. King & Sons, 2 and 4, Great Smith Street, Westminster, London, S. W.
H. S. King & Co., 65, Cornhill, E. C., and 9, Pall Mall, London, W.
Grindlay & Co., 54, Parliament Street, London, S.W.
Luzac & Co., 46, Great Russell Street, London, W.C.
W. Thacker & Co., 2, Creed Lane, London, E.C.
T. Fisher Unwin, Ltd., 1, Adelphi Terrace, London, W.C.
Wheldon & Wesley, Ltd., 2, 3 and 4, Arthur Street, New Oxford Street, London, W. C. 2.
Messrs. East and West, Ltd., 3, Victoria Street, London, S.W. 1.
B. H. Blackwell, 50 and 51, Broad Street, Oxford.
Deighton, Bell & Co., Ltd., Cambridge.
Oliver & Boyd, Tweeddale Court, Edinburgh.
E. Ponsonby, Ltd., 116, Grafton Street, Dublin.
Ernest Leroux, 28, Rue Bonaparte, Paris.
Martinus Nijhoff, The Hague, Holland.
Otto Harrassowitz (Leipzig).
Friedlander and Sohn (Berlin).

IN INDIA AND CEYLON.

Thacker, Spink & Co., Calcutta and Simla.
Newman & Co., Ltd., Calcutta.
R. Cambray & Co., Calcutta.
S. K. Lahiri & Co., Calcutta.
B. Banerjee & Co., Calcutta.
The Indian School Supply Depôt, 309, Bow Bazar Street, Calcutta, and 226, Nawabpur, Dacca.
Butterworth & Co., (India), Ltd., Calcutta.
Rai M. C. Sircar, Bahadur & Sons, 90-2a, Harrison Road, Calcutta.
The Weldon Library, 57, Park Street, West, Calcutta.
Standard Literature Co., Ltd., Calcutta.
Lal Chand & Sons, Calcutta.
Association Press, Calcutta.
The International Buddhist Book Depôt, 4, Chandney Chowk, 1st Lane, Calcutta.
Higginbotham & Co., Madras.
V. Kalyanarama Iyer & Co., Madras.
G. A. Natesan & Co., Madras.
S. Murthy & Co., Madras.
Thompson & Co., Madras.
Temple & Co., Madras.
P. R. Rama Iyer & Co., Madras.
Vas & Co., Madras.
E. M. Gopalakrishna Kone, Madura.
Thacker & Co., Ltd., Bombay.
D. B. Taraporevala, Sons, & Co., Bombay.
Mrs. Radhabai Atmaram Sagoon, Bombay.
Sundar Pandurang, Bombay.
Gopal Narayan & Co., Bombay.
Ram Chandra Govind & Son, Kalbadevi, Bombay.
Proprietor, New Kitabkhana, Poona.
The Standard Book Stall, Karachi, Rawalpindi and Murree.
Mangaldas Har Kishandas, Surat.
Karsandas Narandas & Sons, Surat.
A. H. Wheeler & Co., Allahabad, Calcutta and Bombay.
N. B. Mathur, Superintendent, Nazir Kanun Hind Press, Allahabad.
Munshi Seeta Ram, Managing Proprietor, Indian Army Book Depôt, Juhi, Cawnpore.
Rai Sahib M. Gulab Singh & Sons, Mufid-i-Am Press, Lahore and Allahabad.
Rama Krishna & Sons, Lahore.
Oxford Book and Stationery Co., Delhi.
Superintendent, American Baptist Mission Press, Rangoon.
Proprietor, Rangoon Times Press, Rangoon.
The Modern Publishing House, Ltd., 70, Sparks Street, Rangoon.
Manager the "Hitavada," Nagpur.
S. C. Talukdar, Proprietor, Students and Co., Cooch Behar.
A. M. & J. Ferguson, Ceylon.
Manager, Educational Book Depôts, Nagpur and Jubbulpore.*
Manager, of the Imperial Book Depôt, 63, Chandney Chauk Street, Delhi.*
Manager, "The Agra Medical Hall and Co-operative Association, Limited" (Successors to A. John & Co., Agra).*
Superintendent, Basel Mission Book and Tract Depository, Mangalore.*
P. Varadachary & Co., Madras.*
Ram Dayal Agarwalla, 184, Katra, Allahabad.*
D. C. Anand & Sons, Peshawar.*
Manager, Newal Kishore Press, Lucknow.*
Maung Lu Gale, Proprietor, Law Book Depôt, Mandalay.*
Times of Ceylon Co., Ltd.†

*Agents for the sale of Legislative Department Publications only.
†Agents for the sale of Archæological Publications only.

INDEX.

INDIAN FOREST RECORDS

Vol. X.] 1924 [Part VI.

Volume Tables for *Sal* (*Shorea robusta*) classified by diameter and height.

BY

S. H. HOWARD, B.A.

CHAPTER I.

General.

This Record cancels the figures published in 1922 in Forest Bulletin No. 47, and, as intimated by the Conservator, Working Plans Circle, United Provinces, the figures calculated in the United Provinces in 1922. The Bulletin figures were based on measurements made on 817 trees, of which only 422 were above timber size. Moreover the figures then given only extended to trees of 20″ diameter, approximately 5′ 4″ measured girth, and, as was then stated, the publication was merely an attempt to give available results, while it was not claimed that the figures were strictly accurate.

2. The present figures are based on measurements made on 1,652 trees, of which 1,027 are above timber size. They give figures up to 32″ by diameter and up to 9 ft. measured girth. The number is still inadequate for an entirely reliable result, especially with the irregularities which occur in the trees, but these tables should be far more nearly accurate than the former ones. The large increase in the number of measurements taken is to a great extent due to the work in the United Provinces.

3. In compiling these tables the trees were first arranged in their respective height and diameter classes. Curves were then drawn as carefully as possible for the various diameters of each height class separately. From these the volume, form factor, or whatever the

curve was intended to show, was read off for the *exact* average diameter or girth of a class. Thus, in the diameter class over 12″—16″ the actual average of the trees measured may have shown 13·6″ diameter. From these curves the exact figure for the 14″ diameter tree was read. The corrected data were then plotted over height for each diameter class separately. From these new curves the figure for each exact average of the height class was read off. Thus in the 61—80 ft. height class the actual average from the trees measured may have been 65 ft. From this second set of curves the data for the exact average height of 70 ft. were read. The whole of the corrected data from the combined curves were then replotted for the various exact diameters and for the exact average of the height classes, separate curves being made for each height class. Smooth curves were then redrawn through these points and from those final curves the tables were read off.

In order to increase accuracy a double check was employed wherever possible. Thus from the measured volumes the volume curves were drawn and the equivalent form factors calculated. These were checked again with the original measured form factors.

4. Timber is defined for research purposes to be logs with a minimum mean diameter of 8 inches over bark at the thin end. The actual volume of timber given excludes bark. Smallwood is anything smaller than 8 inches mean diameter over bark at the large end down to a minimum mean diameter of 2 inches over bark at the thin end. The volume given for smallwood includes bark. The timber and smallwood volumes are recorded separately for both branch and stem. The tables give various combinations of these volumes for the benefit of users, and each combination is explained later under the comments on the separate tables.

5. These definitions are used as it is necessary to have some standard for comparison and as a basis to make use of results from one province in another. They are moreover of direct use to the Working Plan Officer who wishes to convert his enumeration figures into volume for the purpose of yield calculation and prescription, and they are probably the soundest figures he can use. *This standard definition of timber does not correspond with the local contractors' conception of timber....As the Divisional Forest Officer for the purpose of his estimates does not want to know some theoretical volume which might be obtained under some other set of conditions, but what actually will be obtained by his contractors in his division, the figures with the standard definitions are of little use to him.* In order that the figures should be of use to him it becomes necessary to find the relation between this standard definition of timber and the amount of the tree in the round which his contractors will actually take. It will probably be possible to devise one or two average standards to cover most of a province, and possibly more than one province; but

there will be exceptional divisions which will need a standard for themselves. It is hoped that local silviculturists will look into this matter and help the Central Institute to devise standards for the various provinces. The United Provinces have already sent in certain figures of outturn. These were collected from various divisions and the table is published. From an examination of the figures sent in the data do not appear to be particularly reliable; but at any rate the table is worth publishing, and can be tested and corrected later, though it is not claimed that it is accurate as it is not possible to trace exactly what degree of supervision there was over the measurements.

6. It may be added that this matter of the collection of data for volume tables based on *local* conversion is a most important one. Even though the use of the total volume of either timber or timber and smallwood combined is the best method for the Working Plan Officer, his figures and prescribed yields as they stand will not indicate to the Divisional Officer the amount of saleable produce in a coupe or tree. Till the Divisional Forest Officer does know exactly what saleable volume will be produced, his own idea of the value of his coupe will be of the vaguest; and no business can rest on a sound basis till the salesman knows the value of the produce he has for sale. The first step in ascertaining the value is to know the utilizable volume in the particular area where the trees are. This is best based on the utilizable timber in the *round*, for the sales whether of standing trees or felled trees are made in the round. The particular material into which it is converted rests with the purchaser, but a further problem is a set of tables showing what sawn outturn will be obtained from this round timber. The quantity will vary with every method of conversion.

It may be asked why have this artificial 8″ limit and not work direct with the local ideas of utilizable material? The answer is that conceptions of utilizable material vary very largely; but an even more important point is that they are not fixed, but change with every improved method of transport, every increase in demand, every rise in price, with improvement in sawing, etc., etc. The only possible basis for a standard table is the ultimate limit, and these tables contain everything down to 2″ diameter.

7. It is the opinion of some officers that the compilation of such tables cannot give the Divisional Forest Officer any real idea of his saleable volume, owing to the practice of selling standing trees and the difficulty of allowing for the unknown factor of "*gauj*". Surely such an argument is unsound. To begin with "*gauj*" does not exist everywhere to such an extent as to upset such estimates entirely. Secondly it may surely be hoped that with thinnings, better management, and the removal of the over mature stock the number of trees affected by "*gauj*" in a given coupe will tend to decrease. But even admitting the factor of "*gauj*" in some divisions and that this necessitates a personal knowledge of the area before the outturn in the round can be known, it is still surely better for the Divisional

Forest Officer to have only this one unknown factor to deal with in order to reduce the general tables rather than that he should have to estimate the whole thing with no tables whatever to help him except possibly some very rough tables. The Central Institute, with the help of some local silviculturists, proposes to try to produce such tables in the coming season and meanwhile is prepared to work up any figures sent in.

8. Six sets of tables are published, classified:

(1) by 4″ diameter classes and 20 ft. height classes.
(2) by 4″ „ „ „ 40 ft. „ „
(3) by 1 foot girth „ „ 20 ft. „ „
(4) by 1 „ „ „ „ 40 ft. „ „
(5) by 1 „ „ „ „ 20 ft. „ „ but with the volumes worked out by the quarter girth method.
(6) by 1 „ „ „ „ 40 ft. „ „ ditto.

9. The following data are given here in the body of the note as a matter of interest and because they may be of some use. The results were obtained in the ordinary course of collection of figures for the tables, and though not so directly useful they may as well be inserted.

Bark percentage in the stem.—As the breast height diameter increases the percentage of bark in the total stem volume including bark decreases. With a fixed diameter and increasing height it probably also decreases, but such decrease was not distinct enough to show the percentage for five height classes. Therefore only two height classes are made *i.e.*, trees below 60 feet height and trees above 60 feet height. No curves are printed but can be easily drawn from the figures below for purposes of interpolation.

Bark percentage.

Diameter class.	Height class.	
	Under 60 ft.	Over 60 ft.
Up to 4″	57	...
Over 4″ to 8″	40	32
„ 8″ to 12″	34	26
„ 12″ to 16″	33	25
„ 16″ to 20″	...	22
„ 20″ to 24″	...	19
„ 24″ to 28″	...	16
„ 28″ to 32″	...	13

Girth class	Height class.	
	Under 60 ft.	Over 60 ft.
Up to 1 foot	·59	...
Over 1 ft. to 2 ft.	41	32
„ 2 ft. to 3 ft.	35	29
„ 3 ft. to 4 ft.	·32	26
„ 4 ft. to 5 ft.	....	23
„ 5 ft. to 6 ft.	...	20
„ 6 ft. to 7 ft.	...	17
„ 7 ft. to 8 ft.	...	14
„ 8 ft. to 9 ft.	...	12

Bark thickness.

So far as could be traced the thickness of the bark at breast height depends only on the diameter of the tree and is not influenced by the height. The following tables give the thickness of the bark for trees of various diameter and girth classes. Please note that it is bark thickness, *not* the amount which must be deducted from a diameter or measured girth over bark to get a diameter or girth under bark. Obviously to get the diameter under bark twice the thickness must be deducted, and to get a girth under bark from a girth measured over bark, the thickness must be multiplied by $2\ \pi$.

Bark thickness.

Diameter class.	Thickness in inches.
Up to 4″	·22
Over 4″ to 8″	·44
„ 8″ to 12″	·71
„ 12″ to 16″	·85
„ 16″ to 20″	·99
„ 20″ to 24″	1·13
„ 24″ to 28″	1·28
„ 28″ to 32″	1·43

Girth class.	Thickness in inches.
Up to 1 ft.	·21
Over 1 ft to 2 ft.	·48
„ 2 ft. to 3 ft.	·68
„ 3 ft. to 4 ft.	·82
„ 4 ft. to 5 ft.	·95
„ 5 ft. to 6 ft.	1·08
„ 6 ft. to 7 ft.	1·22
„ 7 ft. to 8 ft.	1·36
„ 8 ft. to 9 ft.	1·49

Taper Constants.

This table is the most accurate to use for judging the volume of timber in the round of an individual tree.

Taper Constants for Sal.

Half length of bole in feet.	Taper constant.	Half length of bole in feet.	Taper constant.	Half length of bole in feet.	Taper constant.
5	·878	15	·773	25	·708
6	·862	16	·765	26	·702
7	·850	17	·757	27	·696
8	·839	18	·750	28	·690
9	·828	19	·743	29	·684
10	·818	20	·737	30	·678
11	·808	21	·731	31	·672
12	·799	22	·725	32	·666
13	·790	23	·719	33	·660
14	·781	24	·713	34	·655

The table is used as follows. For a tree of which the estimated length of merchantable bole is 36 feet and the breast height diameter

over bark is 16·3″. Half length of bole = 18 feet, taper constant from above table = ·750. Then the diameter under bark at 18 feet high = 16·3″ × ·750 = 12·2″. Basal area corresponding to 12·2″ = ·8118. Therefore volume of timber in round = ·8118 × 36 = 29 cubic feet. The factors can also be used for girths.

CHAPTER II.

Method of using the Tables.

10. The author will be perhaps excused for including this chapter, but volume tables have so far been unavailable in India and their use is not understood by all Indian foresters. Cases have come to light recently where data have been collected of growing stock in such a way that a volume table could not be applied, and it will save a great deal of wasted time if any one wishing to use the tables will realise exactly what data he needs for the purpose.

The first point which must be emphasised is that a volume table cannot give an accurate result if applied to a few trees. It is itself based on averages and can only be applied when the number of trees it is applied to is sufficient to give a true average. Take for example the 16″ to 20″ diameter class. The actual volume of timber in the round measured on the standard definition may be anything from about 30 cubic feet to about 80 cubic feet. In order to lessen the amount of divergence this diameter class is allotted to height classes, but even in one height class, say 81—100 feet, the volume may vary from about 33 cubic feet to about 68 cubic feet, while the figure in the table is 39 cubic feet. It will be seen that to apply the table to one tree is probably less accurate than making an ocular estimate, and certainly less accurate than using the taper table.

11. The use of the tables for a Working Plan Officer is that they enable him to save a large amount of labour in estimating his standing growing stock. Where his forests are regular—that is approximately even-aged—he can apply the yield table (shortly to be published) direct, his only problem being so to allot his area to quality classes that he applies the correct yield table figures; and so to judge the stocking that he is enabled to modify the yield table figures accordingly. Any Working Plan Officer soon learns to do this accurately by eye. The yield table will then give him standing volume, increment, thinnings, etc., etc. But the larger proportion of the existing *sal* forests are too irregular to apply a yield table. It is perforce necessary to work with the individual tree and not with the stock per acre, in other words to use a volume and not a yield table. In some way the Working Plan Officer makes an estimate of his growing stock either for the whole of his forest or, in the event of a conversion from irregular to regular forest, of what will constitute his Periodic Block I. This he does as a rule by enumerations either partial or complete. His final result usually appears somewhat as follows:—

16″—20″	diameter	4,000 trees.
20″—24″	„	4,000 „
24″—28″	„	3,000 „
28″—32″	„	2,000 „

For the sake of example let us assume he wishes to express his standing growing stock in terms of timber in the round on the standard 8″ definition, *i.e.*, Table I and Curve I.

As his figures stand he cannot apply this on any other volume table except one made locally for his particular division, and even that might be inaccurate; it would probably be necessary for him to have a separate table for each small tract in the division.

It will be seen that for each one of the above diameter classes there are separate height classes given in the table, and till he knows into what height classes the trees fall he cannot apply the tables.

It has been suggested that a volume table should be compiled on three of four *quality* classes. This is inaccurate for a *general* table. Quality, meaning quality of locality, can only be applied when the factors of the locality have found true expression. This can only happen in those trees left after a thinning, and where the trees left are not suppressed. It is therefore only truly applicable to a forest which is practically even-aged and thinned, and then a yield table gives truer results. In the case of an unthinned forest, or even a thinned forest of uneven age, and especially with a light demanding tree, the factor of suppression must exist, and the factors of the locality have not found true expression in many trees. A first quality area will contain numerous individual trees which are, owing to suppression, of the same approximate dimensions, though rather different form, as unsuppressed trees of a third quality locality. If then a volume table is made on qualities one of two things is bound to happen. Either the heights of the trees used to compile the table must be a fair average for each diameter class and an average based on dominant, dominated, and suppressed trees, and this would vary with the proportions between various classes and is altogether an impracticable arrangement for the *compilation* of a general volume table; or it must be based on the dominant trees only. Then, however, it means that the enumerator will either have to omit all trees not dominant, in which case his estimated volume will not coincide at all with the actual volume, but will be very much too low; or he will include all trees, which is what he does in practice, and then apply to them the figures of the volume table based on dominant trees, in which case his estimate will come much too high. It is quite true that if based on a large enough number of trees of all kinds, suppressed, dominated, dominant, etc., in a forest which had been worked for many years, and especially with a non-light demander or where the distribution was by even-aged groups, such a volume table could give approximately correct results, but these conditions do not apply to most *sal* forests, and in any case such a table would only apply over a limited area. Consequently in compiling a *general* volume table this height class division is necessary.

12. *Allotment of trees to height classes.*—In some way the trees enumerated must not only be allotted to diameter classes but the respective height classes must also be given. Tables are published here

both for 20 foot height classes and 40 foot classes, so that those who for any reason cannot go to the accuracy of 20 feet may adopt the 40 foot division with correspondingly less accuracy. Far and away the most accurate procedure is for the enumerator and marking officer to *estimate* the total height of each tree as he callipers it, and to place it at once in its proper height class. It is very easy to devise the necessary note book. This is not nearly as tedious or as difficult as it appears at first sight. To begin with a few trees measured at the beginning of each day " gets one's eye in " and it is only necessary to be correct to within 20 feet with one set of tables and 40 feet with the other. Moreover any working plan or marking officer, or any one employed on such work, should be capable of doing this as part of his qualifications, and it is very easily learnt. To illustrate this the writer would like to say that after two months training with the Sachsen Working Plans branch he had to estimate not merely heights, but standing volume and increment over hundreds of acres. These estimates proved correct to within 4 per cent., which is as close as the best results from careful enumerations and sample trees.

Moreover marking officers in certain divisions of the U. P. already estimate the length of merchantable bole for certain trees marked in a coupe, and this requires two separate estimates, first what the merchantable bole is, and secondly what its length is. This actual placing of every tree in its appropriate height class is by far the most accurate method. It avoids any difficulty about qualities, or the proportionate number of suppressed to dominant trees, etc., etc. Errors will always occur in applying a volume table, but while the research officer has to be very accurate over his tables, because he works with comparatively few trees, the forester applying the table judges so many thousands that his errors of judgment largely tend to counteract each other.

Once the number of trees in each diameter and height class is known the application of any table is simple. The trees in each diameter and height class are multiplied by the figure given under that class in the table, and the whole added gives the standing volume of that class of material. The form factor could be used instead of the volume direct, but is more tedious. To use form factors the basal area of the diameter class is multiplied by the height of the class, this is multiplied by the number of trees in the class and this last figure by the form factor. As the volumes have been worked out direct it is assumed that nobody will use the form factors, and they are therefore only published for one set of tables in the body of the note, not for use but in order to show the changes in form of the trees of various sizes.

If anyone troubles to work out the volumes from these form factors he will find that they do not correspond *exactly* with the published volumes. It was not worth the very great labour necessary to make these tiny ultimate corrections. All they would do would be to elimi-

nate certain kinks in the curves, not to alter the real shape or position, and the resulting corrections would not increase accuracy, as they are less than the ordinary errors of measurements. The corrections have already been made closer than the errors of measurement.

13. A less accurate but still applicable method is to consider one average height for each diameter class sufficient over certain small tracts, say a compartment or sub-compartment, or even a day's work. This needs much more skill in judging what average height is to be taken for each diameter class, but it avoids the difficulty of estimating the height of each tree. The procedure is then as before, the total number of trees in each diameter class being alloted to one height class and the corresponding volume figure being taken from the tables.

14. An extension of the above idea is to use one average height for each diameter class over a large tract such as a range or even a division. Naturally this is less accurate. The author was asked whether it would not do to take the middle curve, that is the 81—100 foot height class and apply that. *It would not.* In any tract where the trees of the 28″—32″ diameter class fell on the average in the 81—100 foot height class it is perfectly certain that the trees of the 8″—12″ diameter class would not fall on the average in the same height class. They might fall in the 61—80 foot height class, but more likely in the 41—60 foot height class. If a Working Plan Officer wishes to apply this last method he should adopt the following procedure. Make his enumeration by diameter classes as usual. Then judge the average height of each diameter class from his knowledge of the area and that gained in his enumerations, and for each diameter class pick out and carefully measure the diameter and height of certain average trees. The more of such sample trees he measures the better, but it is more important naturally to get the *large* diameter trees correct. From the measured trees in each diameter class work out the average diameter and the average height of the trees in that class. Place on the published curves a dot in the position indicated by this diameter and height, and through this set of dots draw as smooth a curve as possible. This will give a curve, or set of curves, from which a small local volume table applicable to the tract can be compiled. Of course the Central Institute is prepared to do all such work for Working Plan Officers so long as they measure up the trees, and is in fact willing to send men whenever possible to help Working Plan Officers in the matter of collecting statistics. It is earnestly requested that Working Plan Officers will consult the Central Institute in these matters. Even if no help can be given it wastes little time to enquire; but in many cases help can be given. In many cases when help is not given it is because the problem is sent here *after* all the field work has been done and some necessary small point missed out. It would have been nothing to have included the small point from the beginning, but would mean redoing the whole work at the end. It is hoped that extra sets of curves will be available for the purpose of preparing

local tables, but in any case it is not a great labour to redraw the curves from the table figures.

Working Plan Officers will find, if they adopt this method of one average height, that the curves run *across* those in this pamphlet. The method has the great advantage that there is no necessity to judge the height of each tree enumerated.

15. As to whether the accurate 20 foot tables are used, the less accurate 40 foot tables, or the general one-height average for a division must be decided by the local officer. It is entirely dependent on the value of his product. In a large market, where the department receives almost the full retail value of its produce, *i.e.*, its wholesale value differs from the retail only by actual felling and conversion costs and contractors' profits, it is worth while spending more money on exact timber estimating. Where the division is in the back of beyond and the wholesale price is less than the retail by a heavy burden of long transport in addition to the above costs, mistakes in estimates are less important, and the less accurate methods costing less are all that are justified.

16. The following is an example of the method of working indicated under para. 14. From judgment, felled sample trees, or whatever method the Working Plan Officer wishes he obtains the following as the heights of the various diameter classes:

Diameter class.	Average from measured trees.	
	Diameter (inches.)	Height (feet.)
8″—12″	10·6	42
12″—16″	15·3	51
16″—20″	17·2	73
20″—24″	23·1	80
24″—28″	27·0	105
28″—32″	30·2	114

Please see curve 8 at the end. The solid lines are the original curves for stem timber as in curve I. The crosses are the plottings of the above data, and the dotted curve represents the curve for the data found in the example for this division. From it the local volume table would read.

Diameter inches.	Volume stem timber. Cubic feet.
8″—12″	2
12″—16″	16
16″—20″	37½
20″—24″	68½
24″ 28″	121
28″—32″	207

The above figures would then be applied to the enumeration results.

17. Attention must be called to one important point. To whatever accuracy the Working Plan Officer goes in *prescribing* his yield, to that same accuracy must the Divisional Forest Officer go in *marking* his yield against the prescriptions. It is not the slightest use the Working Plan Officer going to 20 foot height classes in prescriptions if the Divisional Forest Officer is going to lump all trees of one diameter class into one average height class. The Working Plan Officer may wish to go to the 20 foot accuracy for other purposes, but in the matter of *prescribed* yield his prescription and the Divisional Forest Officer's volume units for marking and counting against the yield must be the same.

18. In para. 11 it was stated that a *general* volume table could not be compiled based on quality classes. But it will be seen from paras. 15 and 16 that an approximate local table can be made for any tract using one height class for each tract. If then any province wishes to take an average for a tract but prefers that tract to be a scattered one—that is a certain locality quality corresponding to a quality class in a yield table — it is of course possible to do so and to work out a volume table for this tract corresponding to the I, II, or III qualities of a yield table. But it must be remembered that the yield table is for a definite type of crop. An irregular crop growing on the same locality quality will not produce the same trees, except under certain conditions of species and management which we have not attained, and therefore such a local volume table may not be very accurate. Even in the given quality

class the average height (and therefore volume) of trees of a given diameter class will be influenced largely by the various proportions in different areas between suppressed, dominated and dominant trees, and although such a volume table can be made and used great accuracy cannot be expected. It would be made for each quality just as described under paragraphs 15 and 16. Whether such a table is sufficiently accurate for his purpose can only be judged by the local Working Plan Officer. Such a one will be made corresponding to the United Provinces yield table quality classes as soon as data have been collected.

CHAPTER III.

Comments on the Tables and Curves.

Table 1 and Curves 1 and 2.

19. The figures for the curves and table are based on the standard timber definition of 8″ over bark at the small end, but the figures give the volume in the round without bark. There is no comment to make on the volume figures.

The following table gives the equivalent form factors:—

Diameter class. Inches.	Height class. Feet.				
	41′—60′	61′—80′	81′—100′	101′—120′	121′—140′
0—4″	...	...	...	...	...
Over 4″ to 8″	...	...	...	...	...
„ 8″ to 12″	·147	·210	·234	...	...
„ 12″ to 16″	·262	·279	·291	·295	...
„ 16″ to 20″	·328	·317	·315	·313	·308
„ 20″ to 24″	·356	·342	·336	·329	·325
„ 24″ to 28″	...	·368	·357	·344	·337
„ 28″ to 32″	...	·394	·373	·356	345

It will be noticed in the form factor figures that for any given height class the form factors show a regular increase with increasing diameter. This is what would be expected. If, however, the separate diameter classes are examined it will be seen that for the different height classes of that diameter class the course of the form factor is not consistent. In the 8″—12″ diameter class the form factor increases with increasing height as it does in the 12″—16″ diameter class. This is what would be expected, as once stem-timber is formed each increase in height causes a rapid rise in the amount of timber. This rise is not so apparent in the 12″—16″ class. In the 16″—20″ diameter class and all larger classes the reverse is the case. That is, in the larger trees the shorter the tree the better the form factor. This may cause some surprise, but it is so remarkably consistent that it seems undoubtedly correct. It is obviously correct in the extreme limits. For instance a tree of 30″ diameter and only 50 feet height, that is one of the large stumpy poor *sal* trees such as occur on the poorer quality Siwalik areas, though it contains a small *actual* volume of timber, does obviously contain a greater proportionate amount than a rather taller tree of the same diameter. The explanation is probably due to the formation of crown. The crown on the

shorter trees, once they have passed their youth, though large and branchy does tend to form a bulky fat bole. A taller tree tends to be long and attenuated and thereby gives a much greater cylinder proportionate to volume. It is moreover a fact that trees vary in shape from something between an Appolonnian parabaloid and a cylinder down to what is almost if not quite a neoloid and the taller trees tend more towards the neoloid.

If now Curve 2 be examined a picture of what this implies will be seen. It will be noticed that the curves cross. The shortest trees begin with the smallest form factors and end with the largest, though they stop at a diameter of the class 20″—24″. The tallest class does not begin with the largest form factor because no trees were found of that height below the 16″—20″ class, and the crossing has already occurred; but they certainly have the lowest form factors from that point onwards. With all the other height classes it is consistent that the taller the trees are the higher is their form factor below a certain diameter and the lower it is above that diameter. It will also be seen that in the case of four out of the five height classes this crossing point is in the same diameter class, namely 16″—20″; and in the case of three of them at the exact diameter of 17″. The two which are inconsistent are the tallest and the shortest trees, and of these naturally fewer examples were found and the average curves are therefore more liable to error. Form factor curves always exaggerate errors and it will be seen at once that the spacing of these curves is not even. The writer could have evened these up and corrected the volume curves accordingly. The three consistent height classes 61′—80′, 81′—100′, and 101′—120′ naturally provided the largest number of trees, and probably therefore are the truest averages. If then these were taken as correct and the other two spaced evenly on them it will be seen that both would then have crossed at the same point of 17″. It may be wondered why this was not done. The reason is that it is not absolutely certain which is the correct average, and though such a correction would have *looked* more accurate the writer preferred to leave the slight inconsistency and admit that the tables are not yet based on sufficient data to be absolutely accurate. Field tests and more measurements will soon correct any existing errors.

If now Curve 7 be examined a further curious check comes to light. This curve was compiled and drawn at the Central Institute from outturn figures of an entirely different set of trees, none measured by any of the staff of the Central Institute and all sent in by the United Provinces Silviculturist from measurements made all over the province by the staff in the various divisions, and the exact accuracy of the figures is admittedly open to doubt. Yet it will be seen that exactly the same general tendency occurs and that the crossing point is almost at exactly the same diameter, namely 18″. There is one curious difference in these outturn curves which will be commented on under its proper head.

Table II.

20. This shows the volume of timber in the branches on the standard 8″ definition. The volume given excludes bark. It will be noted that for a given diameter the same volume is given for each height class. This necessarily means a decreasing form factor. The curves are not published as there is no point in their publication. There is little doubt that the height *does* influence the volume of branch timber, but the figure is extremely variable, and there were few measurements on which to base the table. The figures are therefore merely a rough general average, and do not pretend to be more. They are, however, quite sufficient for all ordinary purposes. It will be seen that branch timber is first found on the average in trees over 16″ diameter.

Table III and Curves 3 and 4.

21. The table gives the combined amount of wood in the round in both the branches and the stem between the diameters of 8″ and 2″, both measured over bark; and the figure given includes the bark. It does *not* include any wood in the branches over 8″ diameter over bark, as this has already been included in Table II.

There are no comments to make on the table and curves for the volume. From the form factor curve it will be noticed that many of the remarks made about Table I and Curve 2 apply here, except that after a certain stage increasing diameter with fixed height seems to leave the form factor constant, and that this occurs regularly with all heights in the 20″—24″ diameter class. Attention is called to the exact similarity of all the curves. Smallwood begins to form just below 2″ diameter, but no trees of that diameter seem to attain a height of 40 feet. There is an extremely rapid rise then to a maximum form factor at about 6″ to 7″ diameter. The exact maximum point has not been worked out, as it is unnecessary with the 4″ diameter class. From the moment timber is formed the smallwood form factor sinks rapidly, and its actual volume might sink slightly. Later, however, branches begin to influence the figure, and this causes a further and continuous rise in volume and form factor. The rise in form factor (though not in actual volume) ceases at about 23″ diameter. The very slight downward drop in the curves at the end means nothing. It indicates only a difference of ·002 in a form factor calculation, and is probably nothing at all but a very slight error in the volume average. Probably that latter portion of the curve should be a horizontal line.

Table IV and Curve 5.

22. In many divisions all the branchwood, whether it is above the standard timber definition of 8″ or not, is lumped together and sold as smallwood. Hence this table. It is merely a combination of

Tables II and III but with this difference. Whereas Table II excludes bark this Table IV includes bark for the branches, for small-wood is usually measured and sold including bark. No comment is necessary on the curves, which are only published so that they can be used by the local Working Plan Officer who wishes to draw a single divisional curve across them.

Table V and Curves 6 and 7.

23. This table gives the volume of outturn, and is compiled from figures sent in by the United Provinces. They are rough figures only, and it is hoped they will be tested in the field. The following gives the equivalent form factors.

Diameter class. Inches.	Height class. Feet.				
	41′—60′	61′—80′	81′—100′	101′—120′	121′—140′
0—4″	...	...	...	...	...
Over 4″ to 8″	...	...	...	...	...
„ 8″ to 12″	·055	·066	·073	...	...
„ 12″ to 16″	·101	·114	·120	·122	·124
„ 16″ to 20″	·142	·141	·141	·141	·142
„ 20″ to 24″	·152	·148	·143	·140	·140
„ 24″ to 28″	...	·145	·139	·135	·132
„ 28″ to 32″	...	·137	·131	·123	·124

Attention has already been called to the similarity of Curve 7 and Curve 2. But if Curve 2 be compared with Curve 7 it will be seen that there is one remarkable difference. In Curve 2 for every height class the form factor continues to rise with a rising diameter. In Curve 7 this is not so, for there is a maximum round about 20″; and after that a decline, though of course the actual volume continues to rise. An exact explanation cannot be given, but the following may explain it. A diameter of 20″ is equivalent to a measured girth of 5′ 4″. It has been repeatedly asserted in the United Provinces, and is based on a large number of observations, that a great many *sal* trees become hollow after a girth of 5 feet is passed. In the case of the standard definition hollow trees are avoided, and even if a small core of hollowness does exist it is not deducted from the solid volume, as the figures are supposed to be from sound trees. In the case of these outturn figures any hollow trees included would naturally reduce the

outturn, and thereby the form factor, and it is thought that as this decrease comes at the point it does that probably it is the influence of hollowness making itself felt. Even if the measurers were told to avoid hollow trees they probably did include many which contained *some* hollowness.

Table VI.

24. This table is of no particular use, but it is interesting. It is merely the results in Tables I and V placed side by side for comparison, with the percentage figure in a third column. It will be seen that for a given diameter the percentage which the scantling bears to the original 8″ timber volume is remarkably constant. In the case of a single height class the percentage increases with increasing diameter up to a maximum, and then steadily decreases, and this maximum is consistently in the 16″—20″ diameter class. The reason of this decrease after a certain point is easily explainable. Unfortunately the volume of the commercially usable timber in the round was not reliable enough to insert; that compared with the standard 8″ measure would have explained many matters. Still this outturn comparison is by no means useless. The 8″ timber length increases as the tree increases. The contractor however limits his timber usually to the commencement of the real crown, and increase of total height after that will not increase his length of timber. Consequently after that stage there is a bigger rejection between the standard definition and the timber actually used by the contractor. It will be seen also that the decrease in percentage comes in the neighbourhood of the stage at which hollowness commences to increase rapidly.

Tables arranged by 4″ diameter classes and 20 ft. height classes.

(Volumes calculated by full basal area.)

Table I.

*Volume of stem timber in the round excluding bark.**

Diameter class. Inches.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C, ft.
0—4″ .	...	..	...	...	...
Over 4″—8″ .	...	...	...	...	...
„ 8″—12″ .	4	8	11½	...	...
„ 12″—16″ .	14	21	28	35	...
„ 16″—20″ .	29	39	50	61	70½
„ 20″—24″ .	47	63	80	95½	112
„ 24″—28″ .	...	95	118½	139½	161½
„ 28″—32″ .	...	135	165	192	220½

* By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

*Volume of branch timber in the round excluding bark.**

Diameter class. Inches.	HEIGHT CLASS. FEET.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—4″ .	...	...	...	...	...
Over 4″—8″ .	...	...	...	...	...
„ 8″—12″ .	...	...	...	...	...
„ 12″—16″ .	...	...	...	...	...
„ 16″—20″ .	4½	4½	4½	4½	4½
„ 20″—24″ .	9	9	9	9	9
„ 24″—28″ .	...	14	14	14	14
„ 28″—32″ .	...	18½	18½	18½	18½

* The definition of timber in the branches is the same as for timber in the stem.

Table III.

*Volume in the round, including bark, of smallwood, stem and branch.**

Diameter class. Inches.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—4″	...	...	...	...	...
Over 4″—8″	4½	7½	...	...	...
„ 8″—12″	6	7½	9	...	...
„ 12″—16″	7½	8½	9½	10½	...
„ 16″—20″	12½	13½	14½	15½	16½
„ 20″—24″	22	23	24½	25½	27
„ 24″—28″	..	33	35	36½	38
„ 28″—32″	...	45½	45½	47½	49

* By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

TABLE IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

Diameter class. Inches.	HEIGHT CLASS. FEET.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—4″	...	...	...	...	...
Over 4″—8″	4½	7½		...	...
„ 8″—12″	6	7½	9	...	...
„ 12″—16″	7½	8½	9½	10½	...
„ 16″ 20″	18	19	20	21	22
„ 20″—24″	33½	34½	36	37½	39
„ 24″—28″	...	50½	52½	54	55½
„ 28″—32″	...	67	69	71	72½

Table V.

Volume of sawn outturn from averages of United Provinces Divisions. So far as possible sound trees were selected.

Diameter class. Inches.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—4″	...	...	...	...	...
Over 4″—8″	...	...	...	...	...
„ 8″—12″	1½	2½	3½	...	...
„ 12″—16″	5½	8½	11½	14½	17
„ 16″—20″	12½	17½	22½	27	32½
„ 20″—24″	20	27½	34	40½	48
„ 24″—28″	...	37½	46	55	63
„ 28″—32″	...	47	58	69½	79

TABLE VI.

Comparison of volumes given in Table I and Table V. The percentage given is the percentage of the figure in Table V to the equivalent figure in Table I.

Diameter class. Inches.	Height class. Feet. 41′—60′.			61′—80′.			81′—100′.			101′—120′.			121′—140′.		
	Table I.	Table V.	Per cent.	Table I.	Table V.	Per cent.	Table I.	Table V.	Per cent.	Table I.	Table V.	Per cent.	Table I.	Table V.	Per cent.
0—4″	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Over 4″— 8″	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
,, 8″—12″	4	1½	37	8	2½	31	11½	3½	30	...	...	...	...	...	...
,, 12″—16″	14	5½	39	21	8½	40	28	11½	41	35	14½	41	...	...	...
,, 16″—20″	29	12½	43	39	17½	45	50	22½	45	61	27	44	70½	32½	46
,, 20″—24″	47	20	43	63	27½	44	80	34	43	95½	40½	42	112	48	43
,, 24″—28″	...	...	...	95	37½	39	118½	46	39	139½	55	39	161½	63	39
,, 28″—32″	...	...	...	135	47	35	165	58	35	192	69½	36	220½	79	36

Tables arranged by 4″ diameter classes and 40 ft. height classes. The actual classes are 41—80 ft. 81—120 ft. and 121—140 ft. The last class is only 20 ft. as so few trees occur over 140 ft.

(Volumes calculated by full basal area.)

Table I.

*Volume of stem timber in the round excluding bark.**

Diameter class. Inches.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—4″	...	...	...
Over 4″—8″	...	...	...
„ 8″—12″	6	13	...
„ 12″—16″	17½	31½	...
„ 16″—20″	34	55½	70½
„ 20″—24″	55½	88	112
„ 24″—28″	83	129	161½
„ 28″—32″	118½	178½	220

* By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

Volume of branch timber in the round excluding bark.†

Diameter class. Inches.	Height class. Feet. 41—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—4″	...	...	...
Over 4″—8″	...	...	...
„ 8″—12″	...	...	...
„ 12″—16″	...	...	...
„ 16″—20″	4½	4½	4½
„ 20″—24″	9	9	9
„ 24″—28″	14	14	14
„ 28″—32″	18½	18½	18½

† The definition of timber in the branches is the same as for timber in the stem.

Table III.

Volume in the round, including bark, of smallwood, stem and branch *.

Diameter class. Inches.	Height class. Feet. 41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—4″	...	...	...
Over 4″—8″	6	...	...
„ 8″—12″	7	10	...
„ 12″—16″	8½	10	...
„ 16″—20″	13	15	16½
„ 20″—24″	22½	25	27
„ 24″—28″	32½	35½	38
„ 28″—32″	43½	46½	49

* By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

TABLE IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

Diameter class. Inches.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—4″	...	...	...
Over 4″—8″	6	...	...
„ 8″—12″	6½	9½	...
„ 12″—16″	8	10	....
„ 16″—20″	18½	20½	22
„ 20″—24″	34	36½	39
„ 24″—28″	50	53	55½
„ 28″—32″	66½	70	72½

TABLE V.

Volume of sawn outturn from averages of United Provinces Divisions So far as possible sound trees were selected.

Diameter class. Inches.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—4″	...	...	...
Over 4″—8″	...	...	...
„ 8″—12″	2	4	...
„ 12″—16″	7	13	17
„ 16″—20″	15	25	32½
„ 20″—24″	24	37½	48
„ 24″—28″	32½	50½	63
„ 28″—32″	42½	63½	79

Tables arranged by 1 foot girth classes and 20 ft. height classes.

(Volumes calculated by full basal area.)

TABLE I.

*Volume of stem timber in the round excluding bark.**

Girth class. Feet.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	...	...	...	...	...
„ 2′—3′	3	7	10	...	...
„ 3′—4′	11	17½	24	30	...
„ 4′—5′	24	33	43	52	...
„ 5′—6′	40½	54	68½	82	97
„ 6′—7′	...	80½	101	119½	139
„ 7′—8′	...	115	142	166	191
„ 8′—9′	...	156	189	218	252

* By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

*Volume of branch timber in the round excluding bark.**

Girth class. Feet.	HEIGHT CLASS. FEET.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	....	....	....	....	...
Over 1′—2′	....	....	...	...	...
„ 2′—3′	...	..	...	...	...
„ 3′—4′	...	...	...	...	...
„ 4′—5′	3½	3½	3½	3½	3½
„ 5′—6′	7½	7½	7½	7½	7½
„ 6′—7′	12	12	12	12	12
„ 7′—8′	....	16½	16½	16½	16½
„ 8′—9′	...	21	21	21	21

* The definition of timber in the branches is the same as for timber in the stem.

TABLE III.

*Volume in the round, including bark, of smallwood, stem and branch.**

Girth class. Feet.	HEIGHT CLASS. FEET.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	4½	7½	...	...	...
„ 2′—3′	6	7½	9	...	...
„ 3′—4′	7	8	9½	10	..
„ 4′—5′	10	11	12½	13½	...
„ 5′—6′	18½	20	21	22	23½
„ 6′—7′	...	29½	30½	32	33
„ 7′—8′	...	39	40½	42½	44
„ 8′—9′	...	48	50½	52½	54

* By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

TABLE IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

Girth class. Feet.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	..
Over 1′—2′	4½	7½	...	...	...
„ 2′—3′	6	7½	9	...	..
„ 3′—4′	7	8	9½	10	...
„ 4′—5′	14	15	16	17	...
„ 5′—6′	28	29	30½	32	33
„ 6′—7′	...	44	45½	47	48½
„ 7′—8′	...	59	61	63	64½
„ 8′—9′	...	74	76	78	79½

TABLE V.

Volume of sawn-outturn from averages of United Provinces Divisions. So far as possible sound trees were selected.

Girth class. Feet.	Height class. Feet.				
	41′—60′.	61′—80′.	81′—100′.	101′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.	C. ft	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	...	...	...	...	...
„ 2′—3′	1	2	3	...	...
„ 3′—4′	4½	7	9½	12	...
„ 4′—5′	10	14½	19	23	27½
„ 5′—6′	17½	24	30	36	42½
„ 6′—7′	...	33	41	48½	56½
„ 7′—8′	...	42½	52	62½	71½
„ 8′—9′	...	51	63½	75½	86

Tables arranged by 1 foot girth classes and 40 ft. height classes. The actual classes are 41—80 ft., 81—120 ft. and 121—140 ft. The last class is only 20 ft. as so few trees occur over 140 ft.

(Volumes calculated by full basal area.)

TABLE I.

*Volume of stem timber in the round excluding bark.**

Girth class. Feet.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	5	11	...
„ 3′—4′	14	27	...
„ 4′—5′	28½	47½	...
„ 5′—6′	47	75½	97
„ 6′—7′	70½	110½	139
„ 7′—8′	100½	154	191
„ 8′—9	136½	204	252

*By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

*Volume of branch timber in the round excluding bark.**

Girth class. Feet.	HEIGHT CLASS. FEET.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	...	...	...
„ 3′—4′	...	...	...
„ 4′—5′	3½	3½	3½
„ 5′—6′	7½	7½	7½
„ 6′—7′	12	12	12
„ 7′—8′	16½	16½	16½
„ 8′—9′	21	21	21

* The definition of timber in the branches in the same as for timber in the stem.

TABLE III

*Volume in the round, including bark, of smallwood, stem and branch.**

Girth class. Feet.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	6	...	...
„ 2′—3′	6½	9½	...
„ 3′—4′	7½	9½	...
„ 4′—5′	10½	13	...
„ 5′—6′	19	21½	23½
„ 6′—7′	28½	31	33
„ 7′—8′	38	41½	44
„ 8′—9′	46½	51½	54

*By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

Table IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

Girth class. Feet.	Height class. Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0–1′	...	...	...
Over 1′—2′	6	...	...
„ 2′—3′	6½	9½	...
„ 3′—4′	7½	9½	...
„ 4′—5′	14½	16½	...
„ 5′—6′	28½	31	33
„ 6′—7′	44	46	48½
„ 7′—8′	58½	62	64½
„ 8′–9′	73	77	79½

Table V.

Volume of sawn outturn from averages of United Provinces Divisions So far as possible sound trees were selected.

Girth class. Feet.	Height class, Feet.		
	41′—80′.	81′—120′.	121′—140′.
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	1½	3	...
„ 3′—4′	5½	10½	...
„ 4′—5′	12	21	27½
„ 5′—6′	20½	33	42½
„ 6′—7′	28½	44½	56½
„ 7′—8′	37	57	71½
„ 8′—9′	46	69½	86

Tables arranged by 1 foot girth classes and 20 ft. height classes.

(Volumes calculated by quarter girth measurement.)

Table I.

*Volume of stem timber by quarter girth excluding bark.**

Girth class. Feet.	Height class. Feet.				
	41′—60′	61′—80′	81′—100′	101′—120′	121′—140′
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	...	...	...	...	...
,, 2′—3′	2½	5½	8	...	...
,, 3′—4′	8½	13½	19	23½	..
,, 4′—5′	19	26	33½	41	...
,, 5′—6′	32	42½	54	64½	76
,, 6′—7′	...	63	79½	94	109
,, 7′—8′	...	90½	111½	130½	150
,, 8′—9′	...	122½	148½	171	198

*By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

*Volume of branch timber in the round excluding bark.**

Girth class. Feet.	HEIGHT CLASS. FEET.				
	41′—60′	61′—80′	81′—100′	101′—120′	121′—140′
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	...	...	...	...	...
„ 2′—3′	...	...	...	...	...
„ 3′—4′	...	...	...	...	...
„ 4′—5′	2½	2½	2½	2½	2½
„ 5′—6′	6	6	6	6	6
„ 6′—7′	9½	9½	9½	9½	9½
„ 7′—8′	...	13	13	13	13
„ 8′—9′	...	16½	16½	16½	16½

*The definition of the timber in the branches is the same as for timber in the stem.

TABLE III.

*Volume in the round, including bark, of smallwood, stem and branch.**

Girth class. Feet.	Height class. Feet.				
	41′—60	61′—80′	81′—100′	101′—120′	121′—140′
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′ . .	...	...	...	...	...
Over 1′—2′ . .	3½	6	...	...	...
„ 2′—3′ . .	4½	6	7	...	...
„ 3′—4′ . .	5½	6½	7½	8	..
„ 4′—5′ . .	8	8½	10	10½	...
„ 5′—6′ .	14½	15½	16½	17½	18½
„ 6′—7′ . .	..	23	24	25	26
„ 7′—8′ . .	...	30½	32	33½	34½
„ 8′—9′ .	...	37½	39½	41	42½

*By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

TABLE IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

Girth class. Feet.	Height class. Feet. 41′—60′	61′—80′	81′—100′	101′—120′	121′—140′
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′ . .	...	...	...	...	...
Over 1′—2′ . .	3½	6	...	...	...
„ 2′—3′ . .	4½	6	7	...	...
„ 3′—4′ . .	5½	6½	7½	8	...
„ 4′—5′ . .	11	12	12½	13½	...
„ 5′—6′ . .	22	23	24	25	26
„ 6′—7′ . .	...	34½	35½	37	38
„ 7′—8′ .	...	46½	48	49½	50½
„ 8′—9′ . .	...	58	59½	61	62½

TABLE V.

Volume of sawn outturn from averages of United Provinces Divisions. So far as possible sound trees were selected.

Girth class. Feet.	Height class. Feet.				
	1′—60′	61′—80′	81′—100′	101′—120′	121′—140
	C. ft.	C. ft.	C. ft.	C. ft.	C. ft.
0—1′	...	...	...	...	...
Over 1′—2′	...	...	...	...	...
„ 2′—3′	1	1½	2½	...	...
„ 3′—4′	3½	5½	7½	9½	...
„ 4′—5′	8	11½	15	18	21½
„ 5′—6′	13½	19	23½	28½	33½
„ 6′—7′	...	26	32	38	44½
„ 7′—8′	...	33½	41	49	56
„ 8′—9′	...	40	50	59½	67½

Tables arranged by 1 foot girth classes and 40 ft. height classes. The actual classes are 41—80 ft., 81—120 ft. and 121—140 ft. The last class is only 20 ft. as so few trees occur over 140 ft.

(Volumes calculated by quarter girth measurement.)

Table I.

*Volume of stem timber by quarter girth excluding bark.**

Girth class. Feet.	Height class. Feet.		
	41′—80′	81′—120′	121′—140′
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	4	8½	...
„ 3′—4′	11	21	...
„ 4′—5′	22⅓	37⅓	...
„ 5′—6′	37	59½	76
„ 6′—7′	55½	86⅓	109
„ 7′—8′	79	121	150
„ 8′—9′	107	160	198

* By definition stem timber includes all material in the stem down to 8″ diameter over bark, but the volume given excludes bark.

TABLE II.

Volume of branch timber in the round excluding bark.†

Girth class. Feet.	Height class. Feet. 41′—80′	81′—120′	121′—140′
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	...	...	...
„ 3′—4′	...	...	...
„ 4′—5′	2½	2½	2½
„ 5′—6′	6	6	6
„ 6′—7′	9½	9½	9½
„ 7′—8′	13	13	13
„ 8′—9′	16½	16½	16½

† The definition of timber in the branches is the same as for timber in the stem.

Table III.

*Volume in the round, including bark, of smallwood, stem and branch.**

Girth class. Feet.	Height class. Feet. 41′—80′	81′—120′	121′—140′
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	4½	...	...
„ 2′—3′	5	7½	...
„ 3′—4′	6	7½	...
„ 4′—5′	8	10	...
„ 5′—6′	15	17	18½
„ 6′—7′	22½	24½	26
„ 7′—8′	30	32½	34½
„ 8′—9′	36½	40½	42½

* By definition smallwood is anything below 8″ diameter over bark down to 2″ diameter over bark. The volumes given always include bark.

TABLE IV.

Volume in the round of branchwood of all sizes down to 2″ diameter over bark and stemwood between 8″ diameter over bark and 2″ diameter over bark. The volumes include bark.

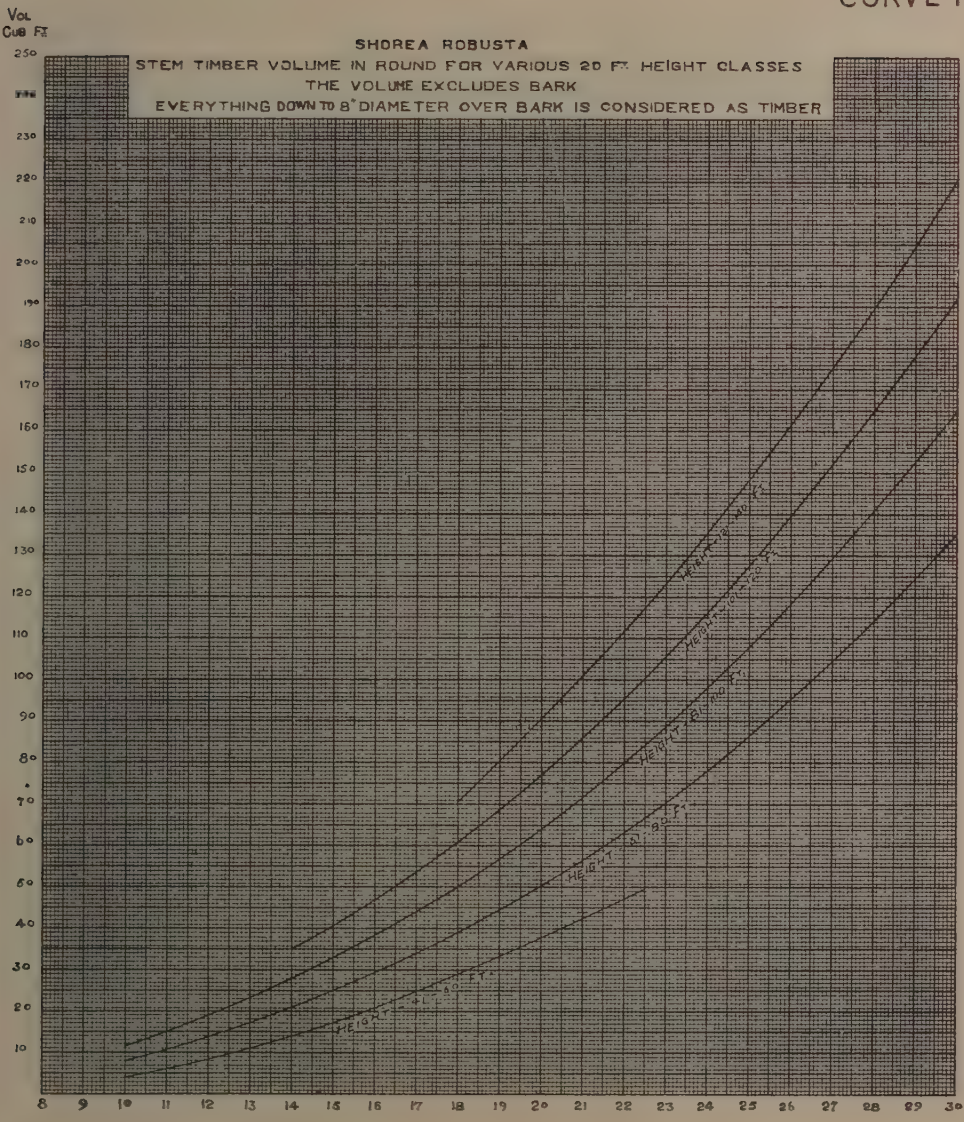
Girth class. Feet.	Height class. Feet.		
	41′—80′	81′—120′	121′—140′
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	4½	...	...
„ 2′—3′	5	7½	...
„ 3′—4′	6	7½	...
„ 4′—5′	11½	13	...
„ 5′—6′	22½	24½	26
„ 6′—7′	34½	36	38
„ 7′—8′	46	48½	50½
„ 8′—9′	57½	60½	62½

Table V.

Volume of sawn outturn from averages of United Provinces Divisions. So far as possible sound trees were selected.

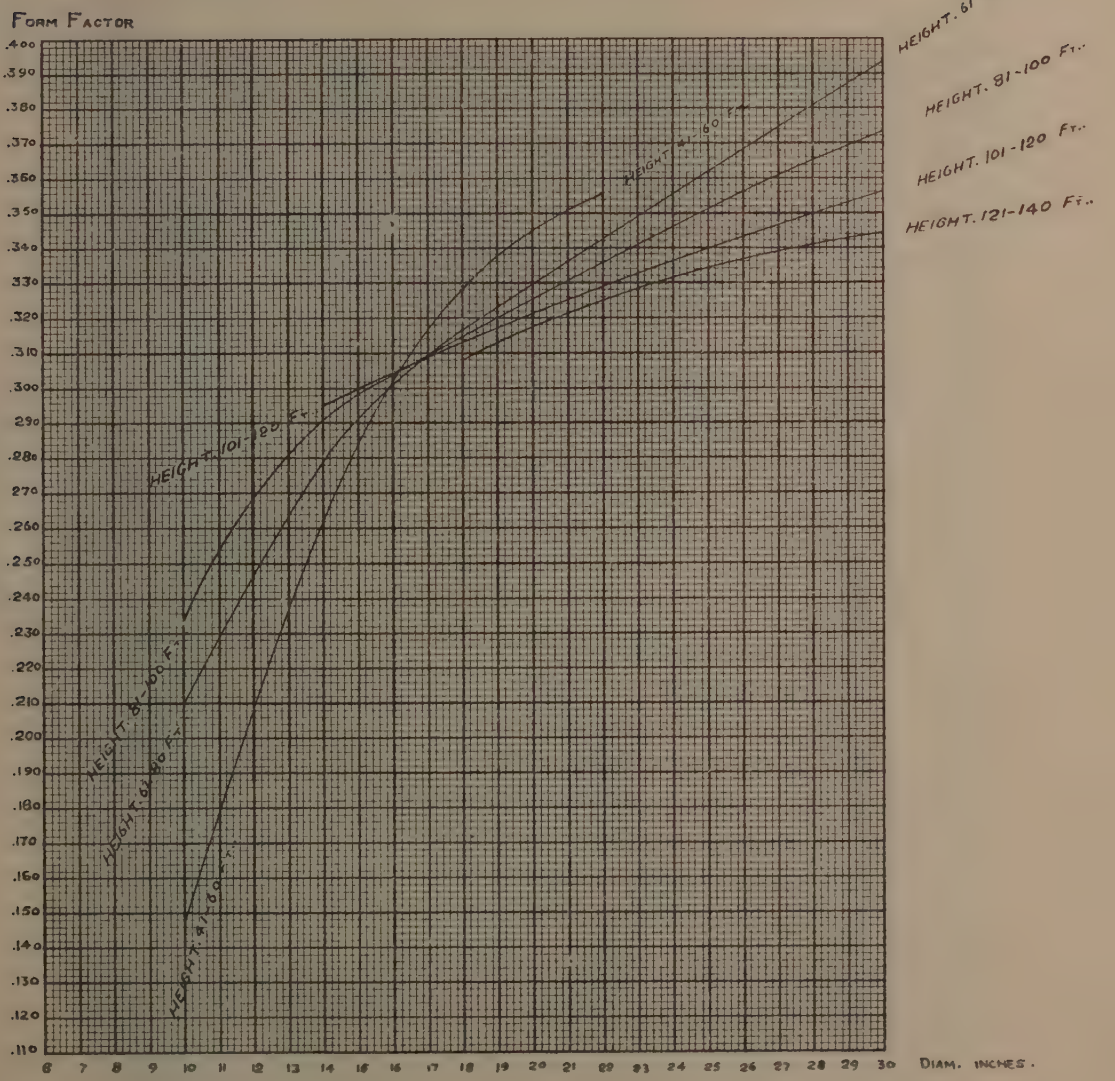
Girth class. Feet.	Height class. Feet.		
	41′—80′	81′—120′	121′—140′
	C. ft.	C. ft.	C. ft.
0—1′	...	...	...
Over 1′—2′	...	...	...
„ 2′—3′	1	2½	...
„ 3′—4′	4½	8	...
„ 4′—5′	9½	16½	21½
„ 5′—6′	16	26	33½
„ 6′—7′	24½	35	44½
„ 7′—8′	29	44½	56
„ 8′—9′	36	54½	67

CURVE I


VOL CUB FT
SHOREA ROBUSTA
STEM TIMBER VOLUME IN ROUND FOR VARIOUS 20 FT. HEIGHT CLASSES
THE VOLUME EXCLUDES BARK
EVERYTHING DOWN TO 8" DIAMETER OVER BARK IS CONSIDERED AS TIMBER
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
HEIGHT 81 TO 100 FT.
HEIGHT 61 TO 80 FT.
HEIGHT 41 TO 60 FT.
HEIGHT 21 TO 40 FT.
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 DIAM. INCHES.

CURVE 2

SHOREA ROBUSTA
STEM TIMBER FORM FACTOR CURVES.



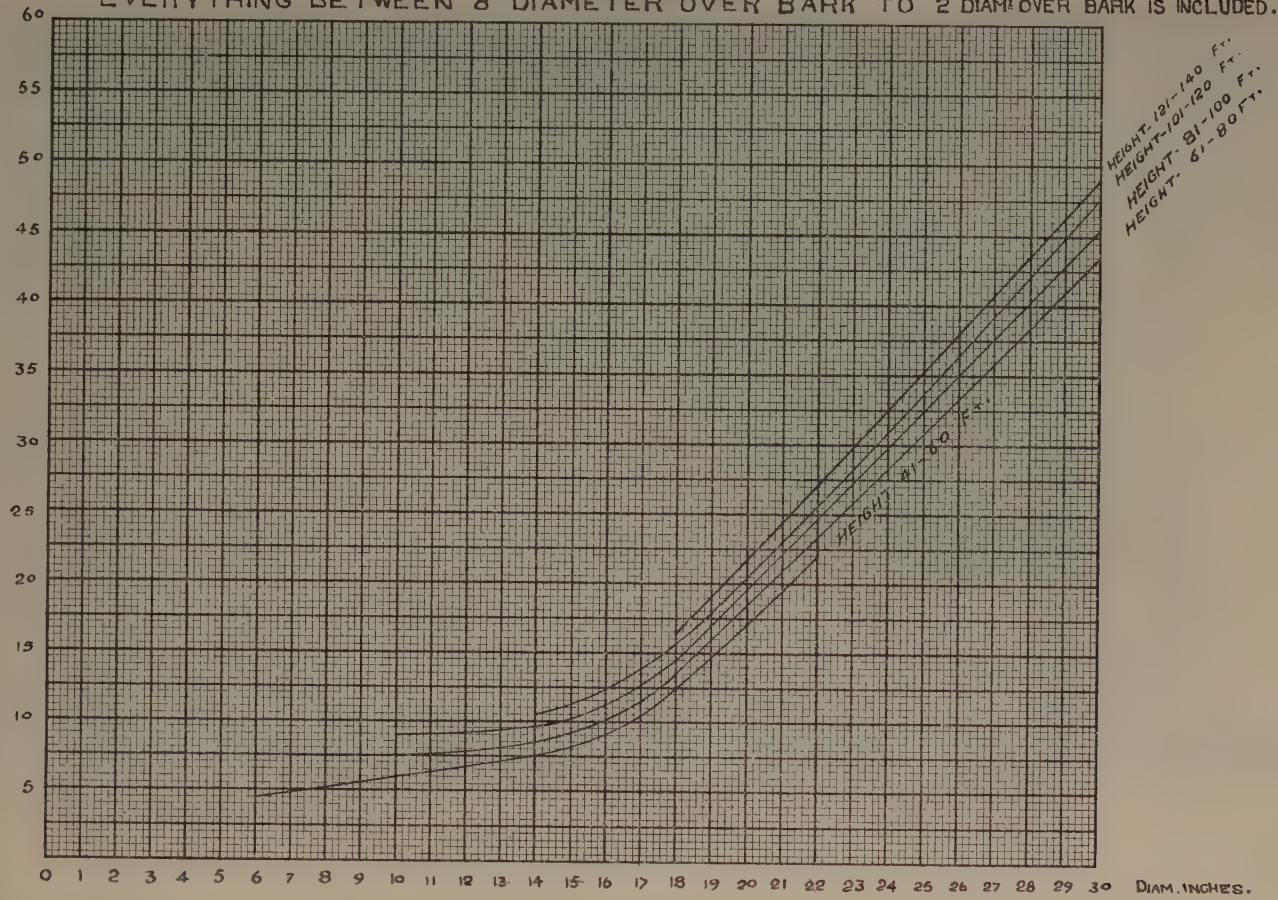
SHOREA ROBUSTA

CURVE 3

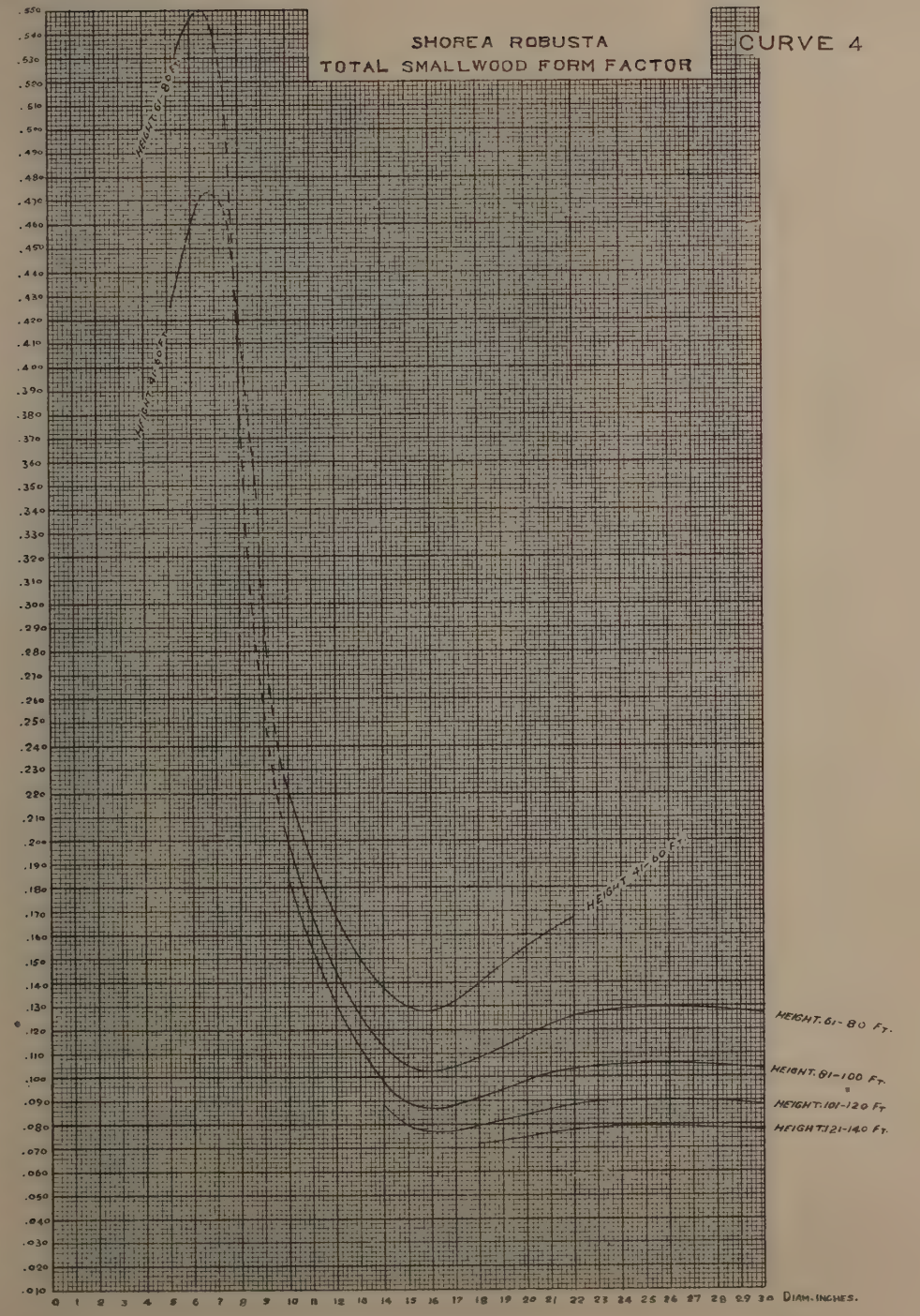
TOTAL SMALLWOOD STEM & BRANCH

THE VOLUME INCLUDES BARK

EVERYTHING BETWEEN 8" DIAMETER OVER BARK TO 2" DIAM. OVER BARK IS INCLUDED.



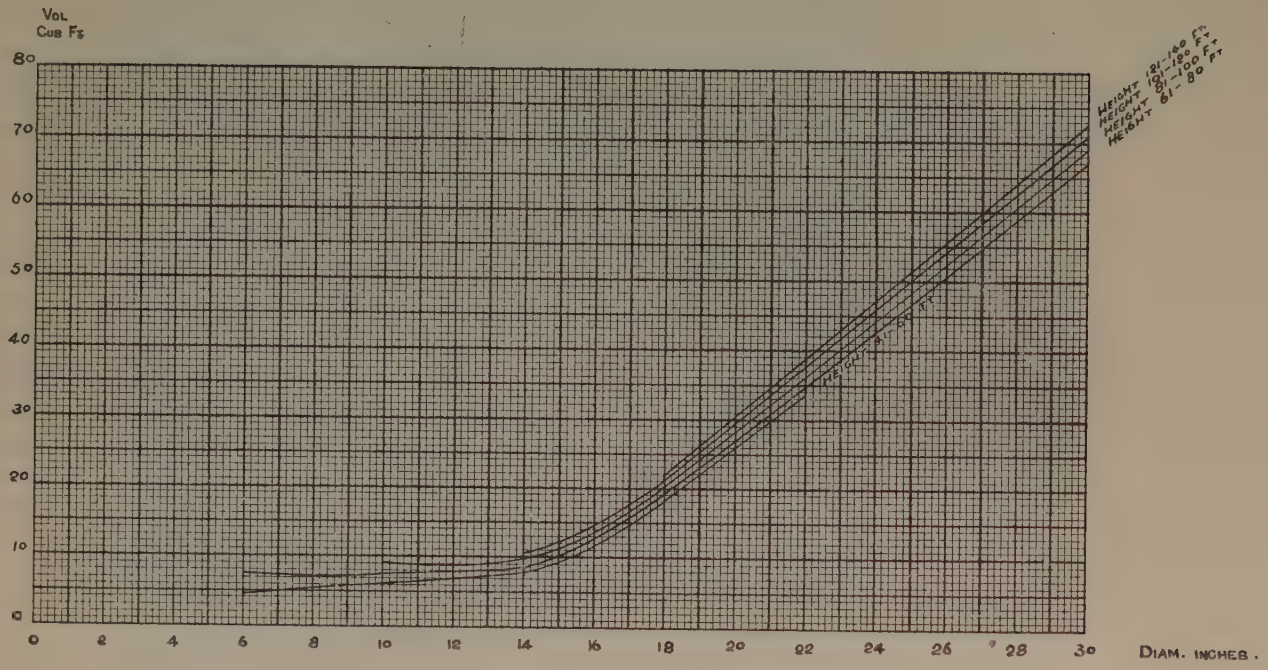
FORM FACTOR


SHOREA ROBUSTA
TOTAL SMALLWOOD FORM FACTOR
CURVE 4
HEIGHT 61-80 FT.
HEIGHT 41-60 FT.
HEIGHT 61-80 FT.
HEIGHT 81-100 FT.
HEIGHT 101-120 FT.
HEIGHT 121-140 FT.
DIAM. INCHES.

CURVE 5

SHOREA ROBUSTA

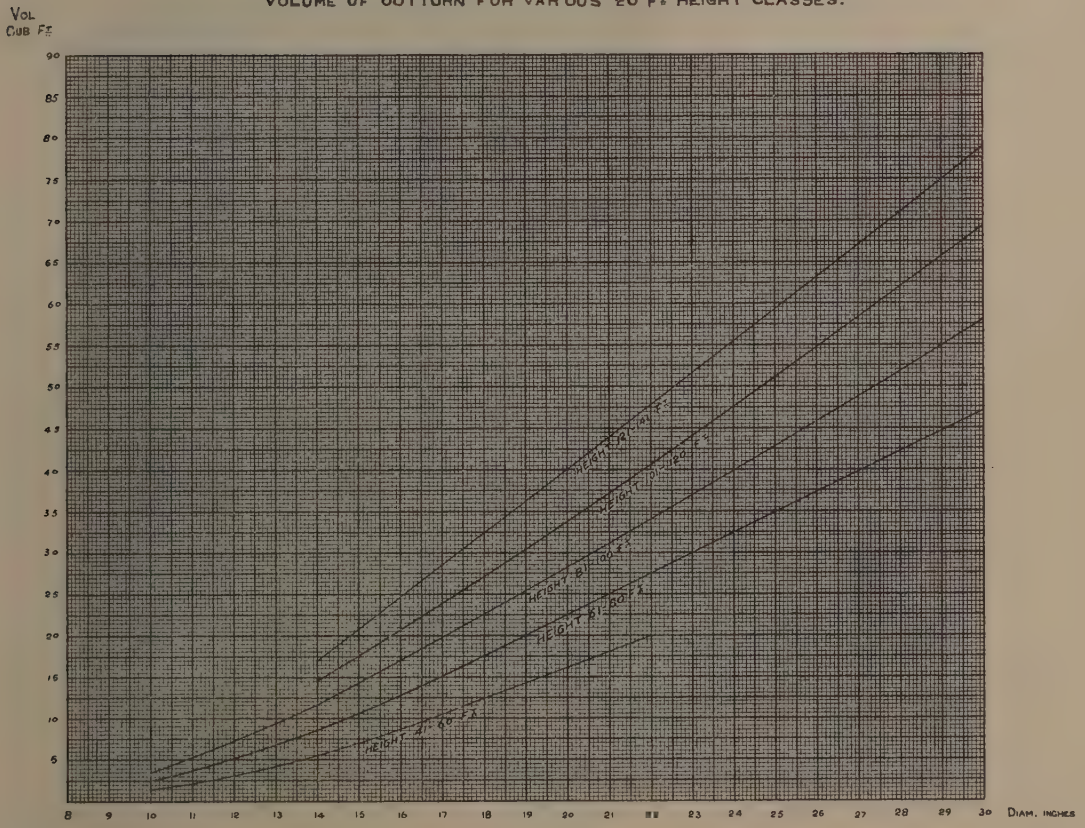
ALL BRANCHWOOD DOWN TO 2" DIAMETER & STEMWOOD FROM 8" TO 2" DIAM.
THE VOLUME INCLUDES BARK



CURVE 6

SHOREA ROBUSTA

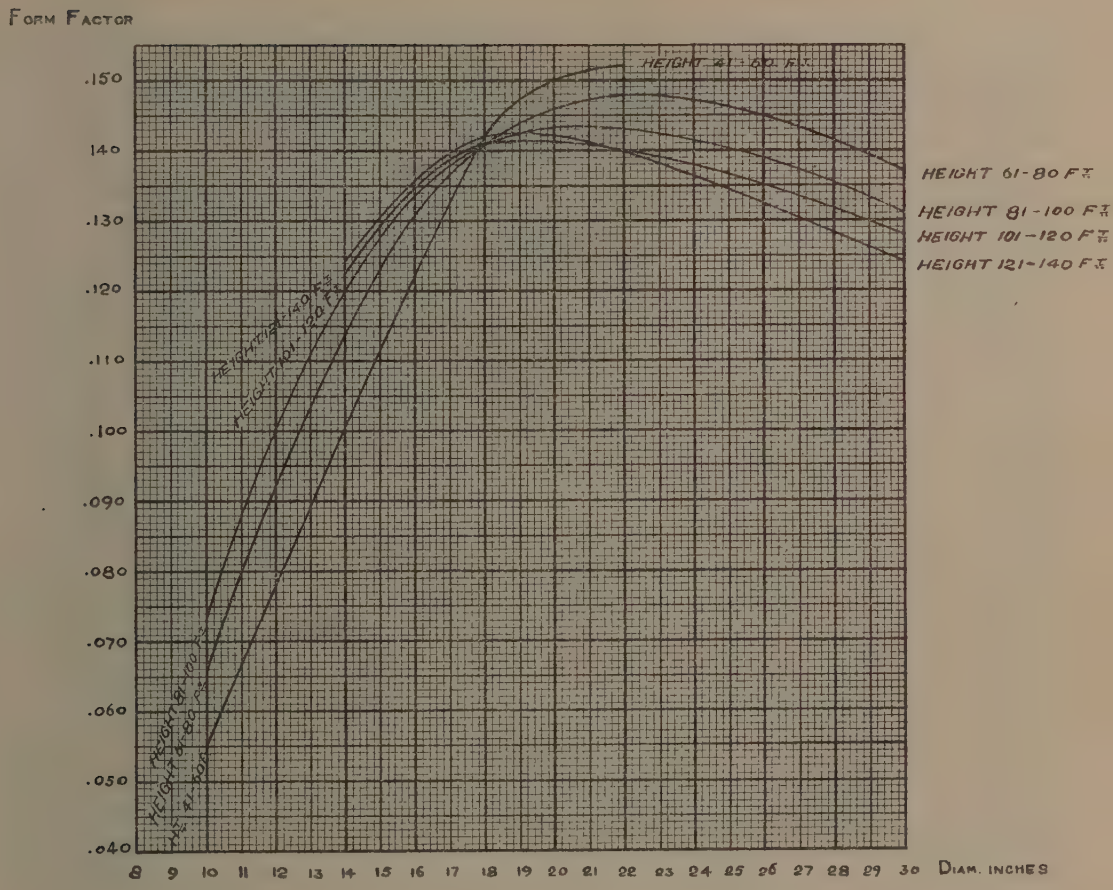
VOLUME OF OUTTURN FOR VARIOUS 20 Ft HEIGHT CLASSES.



CURVE 7

SHOREA ROBUSTA

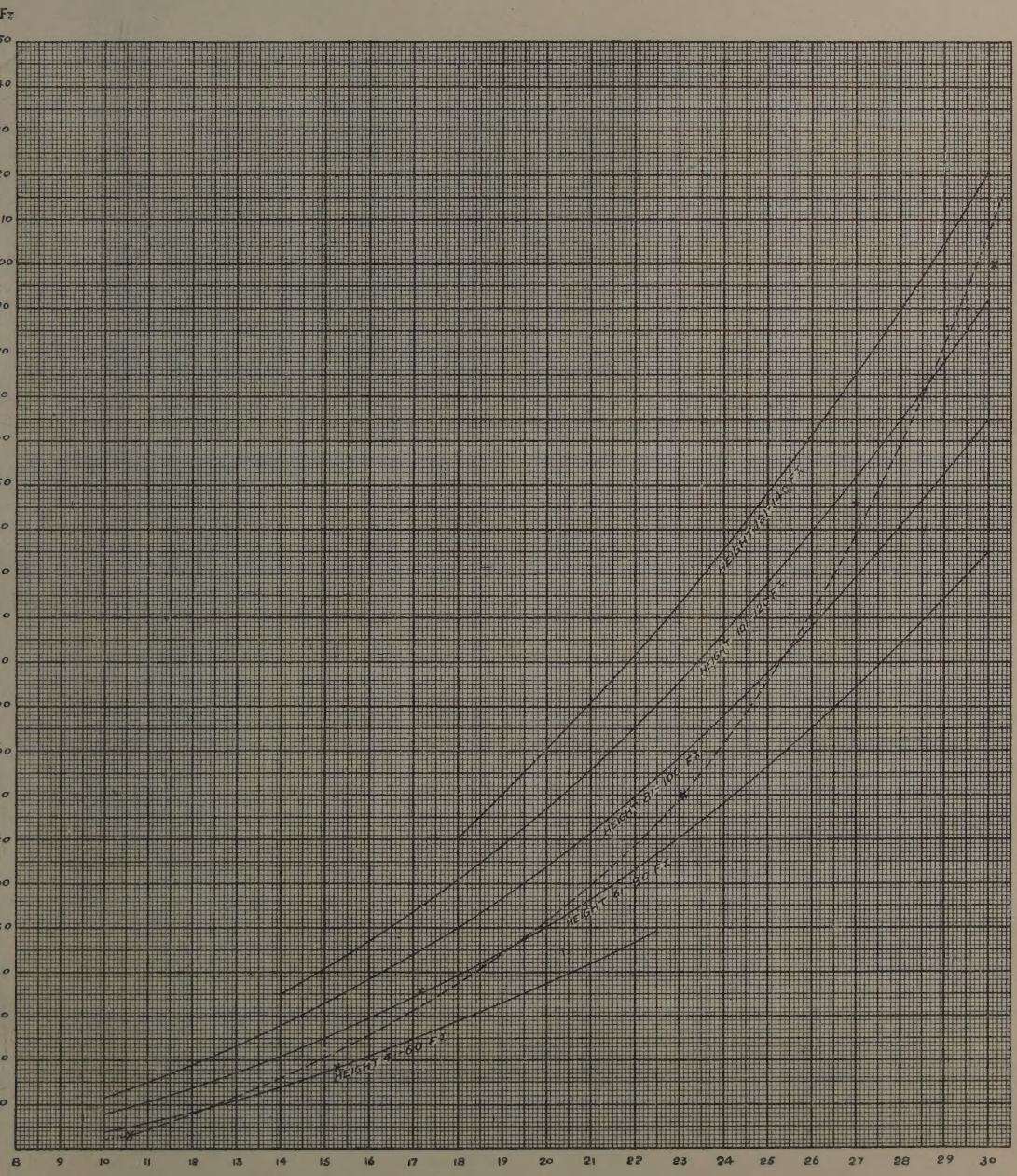
FORM FACTOR CURVES FOR OUTTURN.



CURVE 8

SHOREA ROBUSTA

STEM TIMBER VOLUME IN ROUND FOR VARIOUS 20 Ft HEIGHT SLASSES
THE VOLUME EXCLUDES BARK
EVERYTHING DOWN TO 8" DIAMETER OVER BARK IS CONSIDERED AS TIMBER.



FOREST RECORDS—*contd.*

Vol. V, Part I.—Note on the Tea-box Industry in Assam, by the same author. Price 0-4-0. (*Out of print.*)

,, Part II.—Note on Blue Gum Plantations of the Nilgiris (*Eucalyptus Globulus*), by R. S. Troup, F.C.H., I.F.S., Sylviculturist. Price 1-6-0.

,, Part III. Report on the investigation of Savannah Grasses as Material for Production of Paper-pulp, by W. Raitt, F.C.S., Cellulose Expert. Price 0-4-0 (*Out of print.*)

,, Part IV.
1. Note on Oecology of Sal (*Shorea robusta*), Part I.—Soil-composition, Soil-moisture, Soil-aeration, by R. S. Hole, F.C.H., F.L.S., F.E.S., Botanist. Price 0-6-0
2. Note on Oecology of Sal (*Shorea robusta*), Part II.—Seedling Reproduction in Natural Forests and its Improvement, by the same author. Price 1-1-0.
3. Note on Oecology of Sal (*Shorea robusta*), Part III.—Soil-aeration and Water-cultures, by the same author. Price 0-8-0.

,, Part V.—Note on *Trametes Pini*, by the same author. Price 1-0-0.

,, Part VI.—Note on a new Species of Forest Grass (*Spodiopogon Lacei*, Hole), by the same author. Price 0-8-0.

,, Part VII.—Note on the Economic Uses of Rosha Grass (*Cymbopogon Martini*, Stapf.), by R. S. Pearson, I.F.S., F.L.S., Economist, and Note on the Constants of Indian Geranium Oil (*Motia*), by Puran Singh, F.C.S., Chemical Adviser. Price 1-8-0. (*Out of print.*)

,, Part VIII.
1. Note on the Eucalyptus Oil Industry in the Nilgiris,
2. Note on the Distillation of Geranium Oil in the Nilgiris,
3. Note on the Manufacture of Wintergreen Oil in India,

by Puran Singh, F.C.S., Chemical Adviser. Price 1-0-0. (*Out of print.*)

Vol. VI, Part I.—Note on the Life-History of *Diapus furtivus*, Sampson (Platypodidæ) by C. F. C. Beeson, M.A., I.F.S., Forest Zoologist. Price 0-10-0

,, Part II.—Statistics compiled in the office of the Sylviculturist during 1915-16 Price 1-6-0.

,, Part III.—A Note on Thitsi, *Melanorrhœa usitata*, Wall., with special reference to the Oleo-resin obtained from it, by E. Benskin and A. Rodger, F.L.S. Price 1-2-0. (*Out of print.*)

,, Part IV.—A Further Note on the Antiseptic Treatment of Timber, recording results obtained from past experiments, by R. S. Pearson, F.L.S., I.F.S., Forest Economist. Price 3-0-0.

,, Part V.—Statistics compiled in the office of the Sylviculturist, Forest Research Institute, Dehra Dun, during 1916-17. Price As. 10 or 1s.

,, Part VI.—Note on the preparation of Turpentine, Rosin and Gum, from *Boswellia serrata* (Roxb.) gum-oleo-resin, by R. S. Pearson, F.L.S., I.F.S., Forest Economist and Puran Singh, F.C.S., Chemical Adviser. Price As. 15.

Vol. VII, Part I.—Preliminary Note on the Seasoning of some Indian Timbers, by natural methods, by the same author. Price Re. 1.

,, Part II.—A further note on Thitsi (*Melanorrhœa usitata*, Wall.) with special reference to the oleo-resin obtained from it in the Lawksawk and Mye-hat States, Southern Shan States Forest Division, by F. A. Wright, Provincial Forest Service, Burma. Price As. 4 or 5*d*.

,, Part III.—Note on *Hopea canarensis*, Hole, by R. S. Hole, C.I.E., F.C.H., F.L.S., F.E.S., Botanist. Price As. 3 or 4*d*.

,, Part IV.—Note on *Ixora Butterwickii*, Hole, by the same author. Price As. 3 or 4*d*.

,, Part V.—Notes on the Larvæ and Life-Histories of Prioning Beetles, Coleoptera, Cerambycidæ, Prionini, by C. F. C. Beeson, M.A., I.F.S., Forest Zoologist. Price As. 8 or 9*d*.

,, Part VI.—Note on the Mechanical Strength and Seasoning Properties of *Shorea robusta* (Sal) Timber, by R. S. Pearson, I.F.S., F.L.S., Economist Price As. 8 or 9*d*

FOREST RECORDS—*concld.*

Vol. VII, Part VII.—The Life-History of the Toon Shoot and Fruit Borer, *Hypsipyla robusta*, Moore (*Lepidoptera, Pyralidæ, Phycitinæ*) with suggestions for its control, by C. F. C. Beeson, M.A., I.F.S., Forest Zoologist. Price Rs. 2 As. 4 or 3s. 6*d*.

„ Part VIII.—Note on Afforestation of Ravine Lands in the Etawah District, by E. A. Smythies, I.F.S., Sylviculturist, U.P. Price Rs. 2.

Vol. VIII, Part I.—Report on Lac and Shellac by H. A. F. Lindsay, C.B., I.C.S., and C. M. Harlow, I.F.S., Officers on Special Duty, Lac Enquiry. Price Rs. 2 As. 12.

„ Part II.—The Regeneration of Sal Forests, by R. S. Hole, C.I.E., F.C.H., F.L.S., Botanist. Price Rs. 2 As. 2.

„ Part III.—The Beehole Borer of Teak, by C. F. C. Beeson, M.A., I.F.S., Forest Zoologist. Price Rs. 3.

„ Part IV.—Notes on Artificial Regeneration in Bengal, by Messrs. A. K. Glasson, P. T. Russell, E. O. Shebbeare and L. E. S. Teague. Price Rs. 2.

„ Part V.—The Essential Oil from the leaves of *Abies Pindrow*, Spach, by John Lionel Simonsen. Price As. 2.

Vol. IX, Part I.—Results of Antiseptic Treatment of Sleepers, by R. S. Pearson, C.I.E., I.F.S., Forest Economist. Price Rs. 2.

„ Part II.—On Chalcidoidea (Mainly bred at Dehra Dun, U. P., from pests of *Sal, Toon, Chir* and *Sundri*), by James Waterston, M.A., B.D., D.Sc. Price Re. 1 As. 2.

„ Part III.—Oils and Fats from the Seeds of Indian Forest Trees, Parts I—V, by Madyar Gopal Rau and John Lionel Simonsen, Forest Research Institute. Price As. 3.

„ Part IV.—The Constituents of some Indian Essential Oils, Parts I—VII, by John Lionel Simonsen and Madyar Gopal Rau, Forest Research Institute. Price 0-6-0.

„ Part V.—Further Experiments in the Air Seasoning of Indian Timbers and General Recommendations as to Seasoning Methods, by C. V. Sweet, B.S., M.F., with a chapter on "Damage to Timber by Insects," by C. F. C. Beeson, M.A., D.Sc., Forest Entomologist. Price 2-8-0.

„ Part VI.—The Constituents of some Indian Essential Oils, Part VIII.—The Essential Oil from the gum-oleo-resin of *Boswellia serrata* (Roxb.) by John Lionel Simonsen, Forest Research Institute. Price 0-3-0.

„ Part VII.—Note on the Possibilities of Camphor Cultivation from *Cinnamomum Camphora* in Northern India, by S. H. Howard, W. A. Robertson and J. L. Simonsen. Price 1-4-0.

„ Part VIII.—The Constituents of some Indian Essential Oils, Parts IX and X, by John Lionel Simonsen, Forest Research Institute. Price 0-4-6.

„ Part IX.—Note on the Work of Extraction of Broad Gauge Sleepers from Nepal, by J. V. Collier, I.F.S., Deputy Conservator of Forests, U. P. Price 1-11-0.

Vol. X, Part I.—The Constituents of some Indian Essential Oils, Part XI—The Essential Oil from the Leave of *Cupressus torulosa*, Don., by J. L. Simonsen. Price 0-3-0.

„ Part II.—Oils and Fats from the Seeds of Indian Forest Plants.—Part VI.—The Oil from the Seeds of *Aleurites montana*, Wils, by R. N. Parker, M. Gopal Rau, W. A. Robertson and J. L. Simonsen; and Part VII.—The Oil from the Seeds of *Salvia plebeia*, R. Br., by M. Gopal Rau and J. L. Simonsen. Price.

„ Part III.—A *Sal* (*Shorea robusta*) Yield Table for the United Provinces, by E. A. Smythies, and S. H. Howard. Price 0-9-0.

„ Part IV.—The Constituents of some Indian Essential Oils, Part XII.—The Essential Oil from the Oleo resin of *Pinus Merkusii*, by J. L. Simonsen. Price 0-2-0.

„ Part V.—Investigations of the Tannins and Tanning Properties of certain Burma *Lagerstroemias*, by J. A. Pilgrim, M.S.L., T.C. Price Re. 1-0-0.

4

GCP, D—[illegible]—30-2-21—900